which Prof. Wilson has given us has taken a form which, while it can hardly longer be described as "popular," will be admitted by the more strictly scientific audience, to which it is now better adapted, to be in the highest degree fascinating. The advances which cellular biology has made, and is making at the present moment, can only be described as "leaps and bounds," and to no part of the study of the cell will this apply with greater force than to that dealing with cell-propagation. A question which seemed to our fathers, and for the matter of that to some of ourselves not so very many years ago, as of the simplest nature and capable of being described in half a dozen lines, can no longer be adequately dealt with except in a volume devoted exclusively to it, and by men who make its study the business of their lives. And although works in other languages upon the subject, such as those of O. Hertwig and Henneguy, are available for the student, it is none the less a matter for congratulation that Prof. Wilson has given us in our own speech a work which is second to none in the clear and comprehensive manner in which the facts of cell-structure and division are set forth, and the masterly way in which the principal theories which have been founded upon these facts are stated and criticised. Not the least striking feature of the book is the lavish way in which it is illustrated—a prime necessity in a work of this kind if it is to be easily read and understood. At the same time it is clear that the illustrations are carefully selected in each case with the object of presenting either a special fact or idea. And although, as might be expected from his position as a zoologist, Prof. Wilson has for the most part relied upon material furnished by the animal kingdom in illustration of his subject, he has not hesitated when occasion has offered to draw upon the important series of observations which have accumulated of late years in vegetable cytology.

The subjects dealt with are, in the first place, the general structure of the cell, the phenomena of cell-division, the special structure of germ-cells (ova and spermatozoa), together with the parts played by the several cell-structures in the process of fertilisation, the formation of germ-cells and reduction of their chromosomes. These subjects occupy some two-thirds of the entire book. Much of the remaining third is occupied by an interesting discussion on the nature and probable function or meaning of the several organised constituents of the cell; including, besides the nucleus and its various parts, the centrosome and the so-called archoplasmic structures, *i.e.* the asters and spindle and attraction-spheres. Their chemical relations and their physiological relations to one another are next passed in review, and, lastly, the most abstruse part of the subject—that, namely, which concerns the relation of cell-division to development and inheritance—is dealt with. The able manner in which Prof. Wilson has succeeded in overcoming the difficulty of presenting the various modern theories of inheritance, which are associated with the names of His, Nägeli, Darwin, Roux, de Vries, Weismann and Hertwig, in a comparatively limited space, and with admirable clearness, can only be appreciated by those who have followed the long and apparently interminable manner in which these theories have, like the Pharaoh's serpents which were popular some years ago gradually extended their voluminous coils from a small and apparently inert mass of material, until a theory is ultimately evolved, which, in Prof. Wilson's language, "demands for the orderly distribution of the elements of the germ-plasm a pre-arrayed system of forces of absolutely inconceivable complexity." "What lies beyond our reach at present, as Driesch has very ably urged, is to explain the orderly rhythm of development—the coordinating power that guides development to its predestined end." "The same difficulty confronts us under any theory we can frame." "The controversy between preformation and epigenesis has now arrived at a stage when it has little meaning apart from the general problem of physical causality. What we know is that a specific kind of living substance, derived from the parent, tends to run through a specific cycle of changes during which it transforms itself into a body like that of which it formed a part." "But, despite all our theories, we no more know how the properties of the idioplasm involve the properties of the adult body than we know how the properties of hydrogen and oxygen involve those of water." "We cannot close our eyes to two facts: first, that we are utterly ignorant of the manner in which the idioplasm of the germ-cell can so respond to the play of physical forces upon it as to call forth an adaptive variation; and second, that the study of the cell has on the whole seemed to widen rather than to narrow the enormous gap that separates even the lowest forms of life from the inorganic world." A statement of fact which we must all have recognised, although few of us ever venture to assert it so boldly as Prof. Wilson has here done.

A characteristic feature of the book is a glossary in which obsolete terms are distinguished from those still in use, and in which also are mentioned the name of the author first using the word, and the date of its employment. This and a sufficiently comprehensive, but not too voluminous, bibliography will greatly add to the general usefulness of this admirable work.

E. A. Schäfer.

PRACTICAL PHYSICS.

An Intermediate Course of Practical Physics. By Arthur Schuster, Ph.D., F.R.S., Langworthy Professor of Physics, &c., Owens College, Manchester, and Charles H. Lees, D.Sc., Senior Assistant Lecturer and Demonstrator in Physics in the Owens College, Manchester. Pp. xv + 248. (London: Macmillan and Co., Ltd. New York: The Macmillan Co., 1896.)

ALL who are engaged in the teaching of physics, and all who are interested in scientific education, will take up this "Intermediate Course" with the certainty of finding much in it that is helpful and suggestive, and they will not be disappointed. It fills a distinct place of its own, between the elementary text-books of practical physics and the more advanced manuals. To some, the fact that it has been primarily written with a view to a particular examination, may be a stumbling-block; but, on close examination, there will be found in it nothing that can be fairly considered as "cram." The authors are fortunate in having had the very best help in drawing it up, namely, the criticism of successive generations of

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students who have used the notes from which it is written. In this way it is possible for them to feel certain that, whatever may be the failings of their work, it will at least be intelligible to the average student.

The book opens with a preliminary chapter called "General Instructions," and the practical teacher at once becomes apparent in such paragraphs as that on the importance of *large* errors. No one can have had much experience in teaching practical physics without seeing that the anxiety of beginners to obtain correctness in the second or third place of decimals is accompanied by an extraordinary laxity in noting the tens and hundreds. In fact, it may be said that most of the inaccuracy of beginners in physical measurement is due to this cause. In the chapter on "Arithmetical Calculations," the authors rightly lay stress on contracted methods of multiplication and division. The short chapter on "Graphical Constructions" is less satisfactory than the others, and would probably be improved if some better examples of the method were employed, and if some notice were given to the convention (a most useful one) of making abscissæ represent the independent, and ordinates the dependent, variable.

The body of the book is taken up with experiments on mechanics (including measurement of density and specific gravity), heat, light, sound, and electricity. As necessarily follows from the nature of the case, there is not much that is original in the treatment of these subjects. One admirable feature, however, which runs throughout the course, is the working out of the percentage error in each experiment. In the section on heat, we notice that the calorimeter equivalent is found by pouring warm water into an empty calorimeter; more satisfactory results can generally be obtained by pouring warm water into a calorimeter containing some water at the temperature of the room, and calculating the difference between heat given out by warm water and that taken in by the cold. In this section is also to be noticed an ingenious form of heater for the determination of specific heats by the method of mixtures.

In the optical section the method of tracing rays by means of pins—first used, we believe, in the Cavendish Laboratory—is employed to a considerable extent. There is an experiment on the power of accommodation of the eye, which we have not seen before in any similar work.

The section on "sound" is concerned with the proof of the laws of vibrating strings, and an experiment on the resonance of a column of air. In the last three sections of the book, on "magnetism," "electric currents," and "electric charges," the authors seem to be less successful than in the earlier parts. But it is extremely difficult in the course of fifty pages to give a satisfactory series of experiments on these subjects, especially when, as in this case, a very large number of those pages are taken up with elementary explanations which might have been omitted by reference to any text-book, such as that of Thompson. And the form of water voltameter described is hardly, one would think, the most useful for laboratory purposes, or the most instructive from the point of view of the teacher.

In conclusion we may be permitted to suggest that, from an educational point of view, the book would gain if at the beginning of each experiment a short and clear statement of the object of that experiment were given. One of the most useful results to be obtained from a laboratory course such as this is gained when the student, knowing clearly the question which he is to address to nature, thinks out for himself how he is to proceed in his cross-examination, and compares his method with that of an experienced investigator. D. R.

OUR BOOK SHELF.

Bis an's Ende der Welt! Astronomische Causerien. By Prof. F. J. Studnička. Second enlarged edition. Pp. 212. (Prague: F. Simacek, 1896.)

The author of this book went to Karlsbad to indulge in the special opportunities afforded by that town in the nature of its waters. During his stay there he made the acquaintance of several other "Kurgäste," by name Bausen, Bugajev, Carpenter, Parelli and Place, and his two friends from Prague, Benda and Naprstek. To pass away the time of their sojourn, these persons formed a small social circle, and, besides taking drives together, they met at stated times and discussed any subject that was uppermost in their minds. Carpenter, however, seemed, from all accounts, to be the dominating one of the party from the discussion point of view, and being of an astronomical turn of mind, the conversations generally were on this subject. His listeners were members of several different professions, so the subject had to be treated in an elementary manner, and, in consequence, the explanations had to be very clear.

The author of this book, who was one of the party, describes here the daily conversations which took place; they are mainly astronomical, although other subjects are occasionally referred to. The astronomical and physical problems dealt with are, for the most part, of a very general character, and will be found interesting reading.

A trip to Prague, after the stay in Karlsbad, gives the author a chance of referring somewhat in detail to the associations, works, and lives of Copernicus, Tycho Brahe, Kepler, Doppler, &c., all of whom were intimately connected with that town.

The book may be said to be quite suitable for the general reader, and the numerous diagrams and illustrations scattered throughout its pages will prove serviceable.

First Stage Inorganic Chemistry. By G. H. Bailey, D.Sc., Ph.D. Edited by William Briggs, M.A. Pp 210. (London: W. B. Clive, 1897.)

It is too often forgotten, when criticising text-books written to follow the lines laid down in syllabuses, that the books are not so much to be blamed as the syllabuses. For convenience, it is considered necessary to state the subjects of which a student who presents himself for examination will be expected to know something. The text-book is then produced, in order that the student shall be able to acquire the knowledge in as easy a way as possible. If the syllabus is badly arranged, the text-book designed to meet it will be a bad one; but if the subjects in it are placed in an educational sequence, the text-book will partake of that good quality. Probably no one is better able to judge whether a syllabus hangs together properly or not, than a competent scientific writer who tries to build a book upon it.

The book before us has been arranged to meet the requirements of the Department of Science and Art for the Elementary Stage of Inorganic Chemistry. In eighteen short chapters the author deals with the general principles of chemistry, the nature of chemical reaction, the chief non-metals and their most important compounds, physical properties of gases, chemical nomen-

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